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ABSTRACT

Wildlife is often described as one of Alaska's most important and valuable resources. Helping wildlife can take many forms. This document contains the directions and parts of two games for use with the "Alaska Wildlife Week" materials. The games "Brant for the Future", a simulation of bird and human interactions in the Pacific flyway, and "The Caribou Game", a simulation of caribou population management, are both included. Game boards, activity cards, score cards, background information, directions, and suggestions for modifications and options are contained in this packet. (CW)

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THE BRANT GAME

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THE CARIBOU GAME

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(THESE GAMES ARE REPRINTED FROM ALASKA WILDLIFE WEEK UNIT 3)

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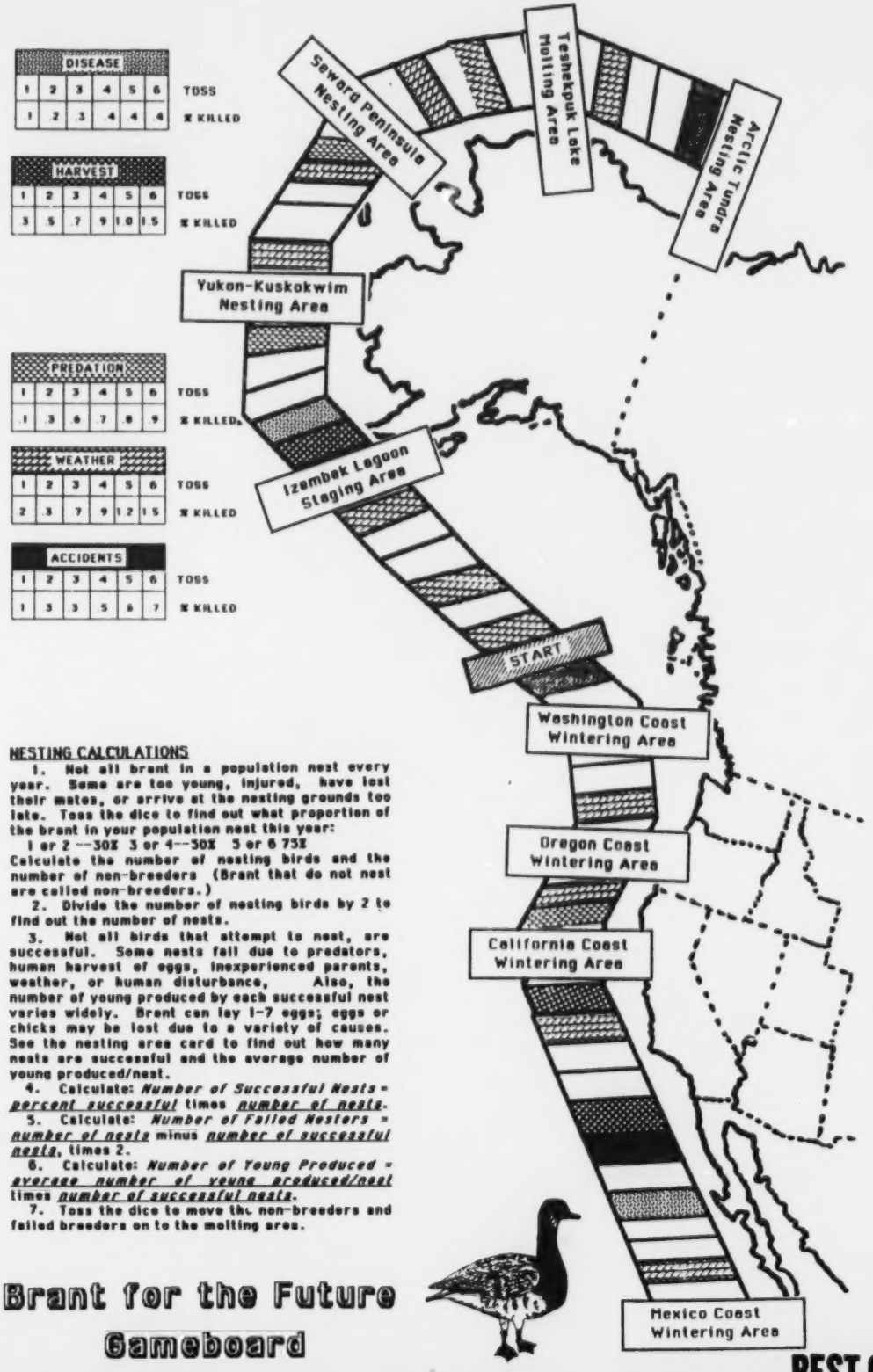

NESTING CALCULATIONS

1. Not all brant in a population nest every year. Some are too young, injured, have lost their mates, or arrive at the nesting grounds too late. Toss the dice to find out what proportion of the brant in your population nest this year:
   1 or 2 --30% 3 or 4--50% 5 or 6 75%
   Calculate the number of nesting birds and the number of non-breeders (Brant that do not nest are called non-breeders.)
2. Divide the number of nesting birds by 2 to find out the number of nests.
3. Not all birds that attempt to nest, are successful. Some nests fail due to predators, human harvest of eggs, inexperienced parents, weather, or human disturbance, Also, the number of young produced by each successful nest varies widely. Brant can lay 1-7 eggs; eggs or chicks may be lost due to a variety of causes. See the nesting area card to find out how many nests are successful and the average number of young produced/nest.
4. Calculate: *Number of Successful Nests* = *percent successful* times *number of nests*.
5. Calculate: *Number of Failed Nesters* = *number of nests* minus *number of successful nests*, times 2.
6. Calculate: *Number of Young Produced* = *average number of young produced/nest* times *number of successful nests*.
7. Toss the dice to move the non-breeders and failed breeders on to the molting area.

Brant for the Future

Gameboard

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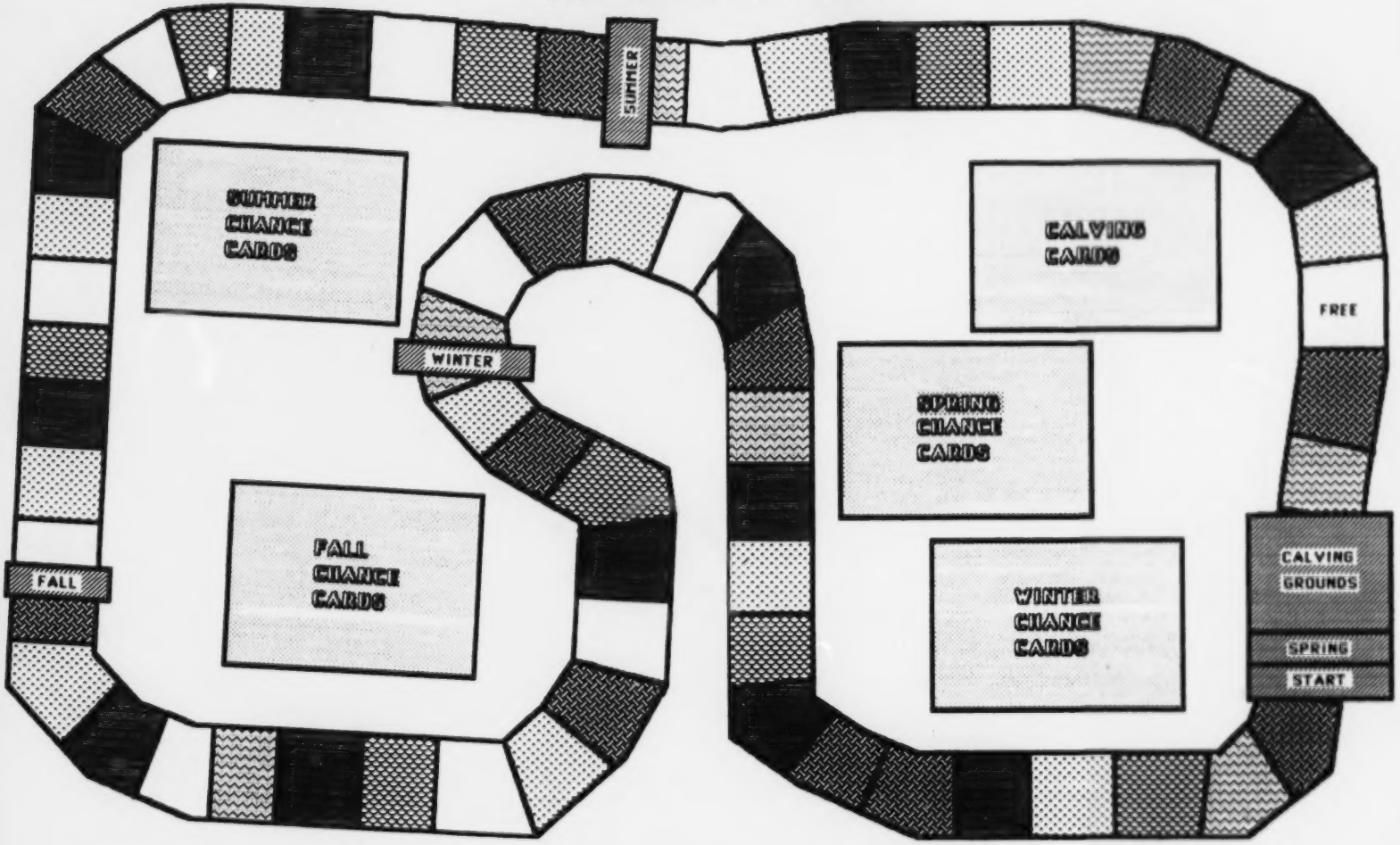
The Caribou Game



Brant for the Future

Instructions for using this game as a class activity to show the effects of habitat loss are given on the next page. **Question**, **Role**, and **Decision Yes Cards**, along with the **Game Board** are included in this packet. The following instructions explain how to calculate population changes.

This game can be played in two ways. The more realistic version requires using three population markers. Divide your class into three groups and assign each group a separate marker. Marker 1 represents a hypothetical beginning Yukon -Kuskokwim (Y-K) nesting population (60,000 brant), Marker 2 represents a hypothetical beginning Seward Peninsula (S-P) nesting population (10,000 brant), and Marker 3 represents a hypothetical, beginning arctic tundra (A-T) nesting population (35,000 brant). Each population migrates north to its respective nesting area, and non-breeders and failed breeders (see Nesting Area card to calculate the number of these each year) migrate to the molting area at Teshekpuk Lake. Each marker moves separately, and calculations for each must be kept separately. The groups can alternate turns throwing the dice. At the end of each "year", the number of birds in each population should be combined to obtain the Total Number of Brant used for graphing population changes.

This game variation better simulates the true situation, in which the total number of brant in the Pacific flyway represents several different sub-populations that nest in different areas. (Brant from different sub-populations may also molt in different areas, but thousands of brant from the Yukon-Kuskokwim, Seward Peninsula, arctic Coastal Plain, and Siberia migrate to Teshekpuk Lake to molt. So, this area was used as the only molting area for the purpose of this game.)

A simplified version of this game is to use just 1 marker representing the Y-K Delta nesting population of 60,000 brant. This population will migrate to its nesting area, non-breeding and failed nesters will "stop-over" at the Seward Peninsula enroute to the Teshekpuk molting area.

OBJECTIVES:

1. Students will learn that the decisions about wildlife use and habitat development made by everyone have a cumulative effect on wildlife populations. They will learn the concept by playing a game that simulates the cumulative effects of decisions made by people throughout the summer, winter, and migratory rangeon a population of brant geese.
2. Students will practice addition, subtraction, multiplication, and division skills by calculating changes in a population size.
3. Students will practice graphing information and interpreting graphs, by working together on a graph of population changes.

MATERIALS:

Brant for the Future Migration Board, Choices for the Future Cards (**Question**, **Role**, and **Decision-Yes**), graph paper, pencils.

PROCEDURE:

1. First explain to students that people make decisions every day that affect the future of wildlife populations. Often the decisions involve a choice between doing or not doing some course of action that will provide people with certain benefits at a cost to some wildlife population or habitat. Usually, the choices are carefully considered. Sometimes the decisions are in favor of people, sometimes in favor of wildlife. Inform students that they are going to get a chance to discuss some hypothetical choices, and make some decisions that will affect the future of people and wildlife.

Divide the class into small groups. Assign each group to one of the areas identified on the Brant for the Future Game Board, and give the group Choices for the Future Cards (Question and Role Cards) for their area. (Don't give away the purpose of the game or show students the game board yet.) Allow 10 minutes for all the groups to discuss the questions on their cards and decide yes or no to each question. At the end of 10 minutes, each group must report their decisions to you. Record these on the blackboard by location and number (i.e., Teshekpuk Lake, Choice 1-yes, Choice 2-no).

2. Briefly, discuss the concept of a wildlife population and the biology of brant geese (Use information on the back of the poster "Wildlife for the Future" or information on the next pages).

3. First the class will investigate what happens to the brant population under natural conditions. Assume a starting population of 10,000 brant. Draw the axes for a graph on the blackboard. Divide the *x* axis into 20, 1-year increments. Divide the y axis into increments of 500, from 5,000 up to 15,000. Have the group assigned to each area toss the dice, read the instructions aloud, and make the calculations when the brant move into their area. Students within the groups can take turns tossing the dice and calculating changes in population size. Instructions for calculating population changes are on the game board. At the end of each "year," when the population has returned to a wintering area, have one student graph the new population size on the blackboard graph. Repeat this for 5-10 years (spring migration, nesting, fall migration, and wintering). What happened to the population over these 10 years? Have the class discuss what happened to cause the population changes.

4. Inform students that brant populations have fluctuated in numbers for thousands of years. A growing human population and development throughout the brant's range have been relatively recent factors affecting brant populations. Over the next 10 "years," they'll find out how the choices they all made earlier will affect the future of the brant population. Place the appropriate Choices for the Future-Decision Yes cards on the board (depending on how students decided) and have students use the instructions on these cards, instead of the calculation instructions on the game board. Then, repeat the exercise above, again rotating the tasks of toss-

ing the dice and reading instructions, making calculations, and graphing the year end population size. Discuss what happened to the brant population during this 10 years. Why did it decline? Who is reponsible? Have the group from each area examine whether the choices they made contributed to the population decline. Ask students to think of ways that the problem of cumulative effects might possibly be reduced.

Possible Evaluation:
Have students write an essay explaining whether or not they think that individual actions, that alone do not make a differenceon the size of populations can have any effect in the long run (on populations).

Instructions:

1. Toss the dice to begin migration. Move Marker 1 the number of squares shown. If the marker lands on a square with a pattern, match the pattern to the appropriate factor (Weather, Predation, Diseases and Parasites, Accidents, or Human Activities). Toss the dice and read the key to find out what percent of the brant in your population died due to that factor. Calculate the change in the population size: New Population Size = Population Size minus Number Dying. Number Dying = (Population Size * percent dying) ÷ 100. Repeat this step for each marker (population).

2. Whenever the marker passes a Staging Area, the flock must stop. Follow the instructions on the associated square (or in Round 2, the appropriate Decision Yes Card) to determine the number that die, or the number of young produced.

3. When a marker reaches its nesting area, follow the instructions in the Nesting Area Box (or Decision Yes card) to calculate 1) the number of non-breeding birds, 2) the number of nests, 3) the number of successful and unsuccessful nests, and 4) the number of young produced.

4. Add together the number of non-breeders, and the number of failed nesters to obtain the number of molting birds. This portion of the flock moves on to the molting area. Toss the dice, move, and calculate the number of birds killed by any factor as the proportion of the number of molting birds.

5. After reaching the molting area, and calculating the number of brant dying there, toss the dice to begin the return migration. The molting birds return to the nesting area to rejoin the rest of their population. (Add together the number of successful nests (times 2 to get number of successful nesting birds), number of young produced, and number of survivors from the molting area. This total flock now continues south, stopping enroute at the Staging Area and each Wintering Area. Based on th results of your toss of the dice, calculate any losses at the Staging Area or Wintering Area in terms of the proportion of this total flock.

6. Upon reaching a wintering area, follow the instructions in the box to determine how many can winter in the area, and how many must fly further south. Then move the marker representing those that must fly further south and calculate any deaths in a wintering area as the proportion of this new number (in each wintering area). Once the entire flock has reached a wintering area, a new year begins. Those in the farthest south wintering area begin migrating and are joined by the others in their population as they pass the other wintering areas.

INFORMATION ABOUT THE ALASKA-NESTING BRANT POPULATION

Brant, like most Alaskan birds, are migratory. They nest in Alaska each summer, then migrate south to spend the winter. Brant are one of the few geese that prefer saltwater for wintering. During summer they nest on small islands in freshwater tundra lakes, usually within 3 miles of the coast. During the rest of the year they live in coastal wetlands, bays and inlets. Their main food is eelgrass, a type of marine plant. Brant do not nest until they are 2 years old. They usually mate for life, and nest in the same general area year after year. Both parents share the nesting duties. Brant usually lay 3-5 eggs, but the average brant family usually includes only 2 or 3 young birds by fall.

(Use the game board map as you discuss the brant's migration route). Over half of the brant that occur in western North America nest on the Yukon-Kuskokwim Delta, but many brant nest on the arctic coastal plain of Alaska, Canada, and Siberia. Young birds, and brant whose nests failed, migrate farther north to summer on large tundra lakes. While on these lakes, they molt their wing feathers and are temporarily flightless. In fall, they migrate south again. Enroute, they stop at coastal wetlands and bays to feed. Nearly the entire population stops over at Izembek Lagoon on the Alaska Peninsula where there is one of the largest eelgrass beds in the world. After putting on extra weight at this rich feeding area, the brant head futher south to winter in bays and lagoons along Oregon, California, and particularly, Baja California, Mexico. In spring, they head north once again with most brant stopping again at Izembek Lagoon on the Alaska Peninsula.

Note to Teachers:
It is important to recognize that the possible effects of the various decisions are purely hypothetical. The kinds of effects are those predicted by biologists, but the magnitude of the effects cannot be predicted with certainty. These examples are purposely designed to show the possible detrimental effects for geese. For example, it is possible that brant in some areas could become accustomed to disturbance, and not be seriously affected. However, these Decision Yes Cards assume that this will not occur. Also, the detrimental effects of various activities can sometimes be minimized by regulations that restrict activities (such as regulations prohibiting helicopter flights) during sensitive periods, or by regulations that limit habitat change in important wildlife areas. As a follow-up discussion with the class, you could discuss how the effects of the various decisions could be minimized by regulations, or other actions. It is also important to recognize that these "decisons" about various projects are only a few examples of the kinds of decisions being made in hundreds of different locations within the brant population's range (and the range of many other migratory species). Thus, the effects of each "decision yes" could be very small, and still have a serious cumulative effect.

ARCTIC TUNDRA NESTING AREA

Toss the dice to determine the number of successful nests, and the average number of young produced per nest:

1 or 2--A late spring makes good nesting sites scarce, and most nests are accessible to predators this year. Only 24% of the nests are successful and only 1.5 young are produced per successful nest.

3 or 4--Weather is moderate, but the vole population is low, so foxes, jaegers, owls, weasels, and other predators switch to preying on bird nests. Only 36% of nests are successful, and 2.3 young are produced per nest.

5 or 6--An early break-up provides excellent nesting conditions. 62% of nests are successful, and 4.2 young are produced per nest.

Neqlernat, Leqlernat
(Pacific Black Brant)

WASHINGTON COAST WINTERING AREA

This bay provides a rich marine environment. Salt marshes around the edges and undeveloped areas provide good wintering habitat for brant and other birds. 20% of your flock can winter here.

TESHEKPUK LAKE MOLTING AREA

All geese molt their wing feathers all at once and become flightless for a few weeks each year. Successful nesters undergo their molt while on the nesting grounds, but non-breeders and failed nesters move to particular molting areas that provide abundant food and safety from predators. Teshekpuk Lake and the surrounding large lakes are one of the most important molting areas in Alaska. Geese travel to this area from as far away as the Yukon-Kuskowkim Delta, Canada, and even Siberia. The molting area is critical for geese, because molting their feathers requires extra nutrients and energy, and because the geese must gain enough weight for the long migration back to the staging, and eventually, wintering areas.

The availability of food , weather, numbers of predators, disease outbreaks, and amount of disturbance at the molting area determines the health and survival of the brant both at the molting site and during the southbound migration. **Toss the dice to determine the survival and health of the molting geese.**

1 or 2--A year of bad weather and rough water causes the flightless geese to stick closer to shore so many fall prey to foxes and other predators. 3% die. Also, the cold weather requires more energy for keeping warm, so birds are not able to put on as much weight. The percent killed on the return migration to the staging area should be increased by 1%.

3 or 4--A year of moderate weather and most geese are able to survive and put on weight. However, a disease outbreak occurs. 1% die. Increase the % killed on the return migration to the staging area by 0.5%.

5 or 6--Good weather, plenty of food, and few predators. Only 0.3% die. Reduce the percent killed on the return migration by 1%

TESHEKPUK LAKE MOLTING AREA - DECISION YES CARD

You decided to allow oil exploration and development in this critical goose molting area. Oil was discovered and now many people are in the area building roads, pipelines, oil wells etc. Helicopter traffic overhead is constant. Some areas once used by geese are now intensively used by people. The geese have been forced out of these areas and are more crowded into other areas. This makes the potential for disease outbreaks more serious, and also means that the amount of food available for each goose is less. Garbage dumps have increased the amount of winter food available for foxes and their populations have increased. So more geese are killed by predators.

Toss the dice to determine the survival and health of the molting geese.

1 or 2--A year of bad weather and rough water causes the flightless geese to stick closer to shore so many fall prey to foxes and other predators. 2.5% die. Also, the cold weather requires more energy for keeping warm, so birds are not able to put on as much weight. In addition disturbance by people causes stress and many birds are unable to gain adequate weight. The percent killed on the return migration to the staging area should be increased by 1.8%.

3 or 4--A year of moderate weather, most geese are able to survive and put on weight. However, a disease outbreak occurs. Because the geese are crowded into a smaller area, 3% die. In addition, disturbance and stress cause many to leave in poor condition. Increase the % killed on the return migration to the staging area by 1.5%.

5 or 6--Good weather, plenty of food, but foxes are abundant. 1% die. Disturbance of nesting birds causes stress, and despite good food supplies, there are more geese than the amount of available food. Many leave the area at a reduced weight. Increase the number killed on the return migration by 0.5%.

ARCTIC TUNDRA-DECISION YES CARD

You decided to allow and encourage mineral exploration. As a result, the area is booming with human activities. Helicopters carrying exploration crews and equipment whirr overhead. Many people have moved in to work on the mineral exploration projects. Roads have been built to a few sites where mineral deposits were found. Some areas have been changed by construction of building pads, work pads, etc. Loss of nesting habitat reduces the number of geese that can find nesting sites, and disturbance of some of the geese causes some nesting failure. Garbage dumps have grown and provide food for various animals, so populations of gulls and foxes have increased.

Toss the dice to determine the percent of successful nests and average number of young produced per nest:

1 or 2--A late spring makes good nesting sites scarce, most nests are accessible to predators this year. In addition, disturbance of nesting birds causes many to fail. Only 15% of nests are successful and on average 0.5 young are produced per nest.

3 or 4--Weather is moderate, but the vole population is low, so foxes, jaegers, owls, weasels, and other predators switch to preying on bird nests. In addition, much disturbance of the nesting birds causes nest desertions and makes eggs easy prey for the now abundant gulls and foxes. Only 28% of nests are successful, and 0.5 young are produced per nest.

5 or 6--This would have been a good production year as weather was mild, but disturbance of nests caused desertions and predation. Only 43% of nests were successful, and 2.2 young are produced per nest.

WASHINGTON COAST WINTERING AREA - DECISION YES

You chose to allow development of the port in order to allow shipping traffic into your town. The heavy ship traffic, along with increased population of your area causes water pollution, and disturbs brant as they stop here. There is less food available as a result of the pollution, and most brant move on. Only 6% of your flock can winter here now.

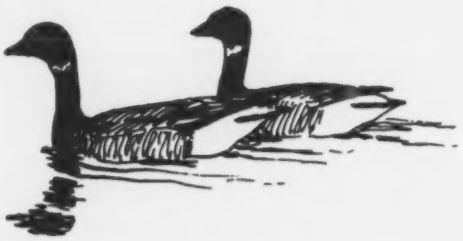
YUKON-KUSKOKWIM NESTING AREA

Toss the dice to determine the number of successful nests, and the average number of young produced per nest:

1 or 2--Heavy rains and late break-up cause flooding over much of the delta. Many nests are destroyed by the flood waters. Only 30% of nests are successful and 1.5 young produced per nest.

3 or 4--Weather is moderate, but the vole population is low, so foxes, jaegers, owls, weasels, and other predators switch to preying on bird nests. Only 40% of nests are successful, with 2.6 young produced per nest.

5 or 6--An early break-up provides excellent nesting conditions. 65% of nests are successful.



OREGON COAST WINTERING AREA

The productive saltmarshes around this bay provide food for brant, and safe places for wintering. 20% of your flock can winter here.

IZEMBEK LAGOON STAGING AREA

This staging area is used by nearly all the brant in the entire Pacific flyway, both in spring and in fall. This area has one of the largest eelgrass beds in the world. The surrounding land is protected by National Wildlife Refuge Status. The area is critical for brant because they must put on enough weight to fly from here to the coast of Washington without any further access to food in the fall. And in spring they must regain the weight lost while flying north in order to be in good shape for nesting, or the further migration to the nesting area. This long over-water journey can be very taxing, especially if the weather is rough.

Toss the dice to find out how the brant fared on their stop at this staging area:

1 or 2--Poor weather during the staging period forces brant to migrate south early and reduces the weight gain of young birds and those in poor health. Increase the percent killed by any factor enroute further north or south by 0.5%.

3 or 4--Moderate weather so birds depart in good shape. Do not change the percent killed by any factor enroute further north or south.

5 or 6--Excellent weather allows brant to linger in the staging area late and put on extra amounts of weight. Even young and unhealthy birds depart in pretty good shape. Reduce the percent killed by any factor by 0.5%.

IZEMBEK LAGOON - DECISON YES CARD

You decided to allow oil exploration and development in the Bering Sea and Bristol Bay area north of Izembek Lagoon. The entire population of brant is crowded into this single area each spring and fall and biologists fear that an oil spill could seriously hurt the population. Also, an oil spill could harm the eelgrass beds and destroy this critical source of food. It is impossible to predict whether or not an oil spill will occur. If any major oil spill was swept into the bay at the wrong time, it would likely destroy the population. Fortunately, no such spill has occurred. But, small oil spills, leaks, and other problems are inevitable.**Toss the dice to find out how the brant fared on their stop at this staging area:**

1 or 2--Only tiny amounts of oil have been spilled. Most oil has been quickly cleaned up, and little has reached Izembek Lagoon. Still, even tiny amounts of oil can ruin the insulation qualities of a brant's feathers. A few birds do get oil on their feathers and die. Calculate the number that die as 0.2% of the population. Also, due to poor weather, some brant don't get enough food before heading on, increase mortality from any factor between here and their nesting or wintering area by 0.5%.

3 or 4--A small oil spill occurs during midwinter. Most of the oil is swept off to the west of Izembek, but a portion of the eelgrass bed is killed by oil that floats in. When the geese return, there is less food available, so some leave the area in poor condition. A few also get small amounts of oil on their feathers. Increase mortality from any factor between here and their nesting or wintering area by 0.5%.

5 or 6--A small oil spill occurs and is washed into the lagoon. It is washed into an area that is not frequently used by brant. All the activity to clean up the spill stirs the geese up; some depart early, and some get mixed up with the spilled oil. Calculate the number dying as 4% of the population. Most brant are unable to gain enough weight. Increase the percent killed by any factor between here and their nesting or next staging area by 1%.

YUKON-KUSKOKWIM--DECISION YES CARD

You decided not to restrict the amount of disturbance and spring harvest of birds. Over the years, the number of people in the area has grown, so many more people are disturbing and harvesting geese.

Toss the dice to determine the number of successful nests and the average number of young produced per nest:

1 or 2--Heavy rains and late break-up cause flooding over much of the delta. Many nests are destroyed by the flood waters. Some of the few remaining birds are harvested by people. Only 13% of the nests are successful, and only 0.7 young produced per nest.

3 or 4--Weather is moderate, but the vole population is low, so foxes, jaegers, owls, weasels, and other predators switch to preying on bird nests. In addition, much disturbance of the nesting birds causes nest desertions and makes eggs easy prey for predators. Only 28% of the nests are successful, and only 1.2 young are produced per nest.

5 or 6--This would have been a good production year as weather was mild, but many adults were harvested and disturbance of nests caused desertions and predation. Only 41% of nests are successful. An average of 2.5 young are produced per nest.

OREGON COAST WINTERING AREA - DECISION YES CARD

You chose to fill in the wetlands around the bay in order to provide more land for homes and businesses. Only a small wetland area remains anywhere in the bay. Only 10% of the brant in your flock are able to winter here. Because others are unable to find enough food to carry them further on migration, more die due to the effects of weather, predators, and other causes. Increase the percent of brant killed by any factor between here and the next wintering area by 1%.

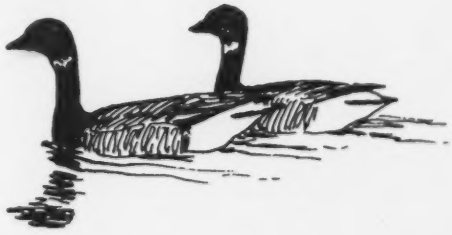
SEWARD PENINSULA NESTING AREA

Toss the dice to determine the number of successful nests, and the average number of young produced per nest:

1 or 2--Due to poor weather on the migration route, many birds arrive late. Many late-hatched young die when the lakes freeze over before they are old enough to fly. Only 24% of nests are successful, 1.8 young produced/ nest.

3 or 4--Weather is moderate, but the vole population is low, so foxes, jaegers, owls, weasels, and other predators switch to preying on bird nests. Only 36% of nests are successful, 2.3 young produced/nest.

5 or 6--An early break-up provides excellent nesting conditions. 60% of nests are successful, 4 young produced/nest.



CALIFORNIA COAST WINTERING AREA

This lagoon provides an undisturbed area of calm water, and adequate salt marsh habitat for wintering brant. 20% of your flock can winter here.

MEXICO WINTERING AREA

This lagoon provides excellent winter habitat for brant. Salt marshes and little human activity make it an ideal location. The remainder of your flock winters here. Because so many brant winter here, it is also popular with waterfowl hunters. 2% are killed by hunters.

CALIFORNIA COAST WINTERING AREA - DECISION YES CARD

You chose to dredge the channel to allow faster access in and out of the lagoon. As a result, some of the saltmarsh in the lagoon was lost. Also the increased boat traffic in the lagoon disturbs the brant, and most do not stay. Only 3% of your flock winters here, the rest move on.

MEXICO WINTERING AREA--DECISION YES

You chose to develop the resort. Many more tourists travel to the area and sightsee in the lagoon by boat. Additionally the number of hunters traveling here to hunt has increased. The resort owners do not want to limit the use of the lagoon by boats or the number of visitors or hunters because they think that would hurt their business. As more hunters now visit the area, more brant are harvested. Also, many brant are forced to move elsewhere as a result of the disturbances--but there are few undisturbed areas remaining. Those that exist are over-crowded, so the brant are poorly nourished, and disease outbreaks are frequent. 7% of those that would have wintered in this area die of a variety of causes.

SEWARD PENINSULA--DECISION YES CARD

You decided to expand the reindeer herding project and allow reindeer to move through and use wetland areas where the geese nest. Over the years, more and more people have become involved in the project, so there has been greater and greater pressure to expand it. Many areas where geese once nested are no longer suitable habitat due to grazing and trampling by reindeer. Additionally, reindeer trample some of the nests each year. Also, the population in this area has grown with the reindeer herding project. As a result, more brant are harvested and disturbed each year.

Toss the dice to determine the average number of young produced per nest:

1 or 2--Late arrival of the birds combined with reindeer use of their nesting area, causes many nests to fail. Only 15% of nests are successful, and only 1.0 young produced/nest.

3 or 4--Weather is moderate, but the vole population is low, so foxes, jaegers, owls, weasels, and other predators switch to preying on bird nests. In addition, disturbance of the nesting birds by reindeer causes nest desertions and makes eggs easy prey for predators. Only 27% of the nests are successful, and only 2.1 young produced/nest.

5 or 6--An early break-up provides excellent nesting conditions. However, predators take many eggs and some nests are trampled by reindeer. Only 42% of nests are successful, and an average of 3.1 young are produced per nest.

Arctic Tundra of Northern Canada

Question: SHOULD OIL EXPLORATION AND DEVELOPMENT BE ALLOWED ON A COASTAL RIVER DELTA NEAR YOUR TOWN?

Role 1. You are in favor of encouraging oil development because it will likely mean more money for your transport company. Also you think that your country needs more oil so that it won't have to rely on foreign countries for this resource.

Role 2. You have mixed feelings about the proposed development. It will likely change the culture and lifestyle of many people in your town, but at the same time it will mean more money for people in the area, better educational facilities, and other benefits.

Role 3. You are opposed to the proposed development project because you love wild areas and do not want them changed by roads, gravel pads, the noise of drills, trucks, and people. Also you think people could get along with less oil if they conserved more.

Role 4. You are in favor of the proposed development because it will mean 800 new jobs for the community and many people are now unemployed or do not have enough money to buy things they need.

Role 5. You are concerned about the effects of the proposed development on wildlife habitat and populations. You realize that loss of habitat will mean less wildlife for people to enjoy and use.

Teshekpuk Lake

Question: SHOULD OIL EXPLORATION AND DEVELOPMENT BE ALLOWED?

Role 1. You think development of natural resources for human use is inevitable and that more people should recognize this and quit trying to control or limit developers.

Role 2. You are a biologist and know that this is a very critical area for molting geese. You can't predict exactly how development will affect the geese but think it is very likely that repeated disturbance by aircraft, and other human activities will cause stress and the birds may abandon this important molting area.

Role 3. You are a government representative in charge of producing the maximum amount of revenue for the government from federal land holdings. Taxes on the oil that might be extracted from this area could yield millions of dollars of revenue.

Role 4. You represent a large company that wants to drill oil wells in this area. Your company will have to spend millions of dollars to develop the resource, but eventually will earn millions more in profits. You point out the benefits of development such as extra money for the state of Alaska that could be used to pay for social programs, the arts, education, etc.

Role 5. You are a resident of a nearby village whose family has used the area for a fish camp for many years. You are concerned that you will no longer be able to use the area if oil development occurs. You also know that oil develoment could provide a low-cost energy source for your village.

Seward Peninsula

Question: **Should the reindeer herding industry be expanded and reindeer herds allowed to graze in wetland areas used by migrating and nesting waterfowl?**

Role 1. You are a stock holder in the corporation that wants to expand the reindeer herding project so you could benefit financially if this project is approved. However, you also enjoy hunting waterfowl and are concerned about whether or not this project will affect the nesting birds.

Role 2. The value of an expansion of the herding project seems very clear. You and many others will likely earn more money which you need in order to buy things you need and send your children to college.

Role 3. You are a biologist in charge of maintaining healthy populations of all wildlife. Research results are not entirely clear, but if reindeer herding is done on a large scale there is little doubt that it would affect the nesting habitat for geese.

Role 4. You are an exporter of reindeer antlers. You have a market for these items that far exceeds the current supply. You would like to see the herding project enlarged so that you can meet this demand and make more money.

Role 5. You remember the old ways, but want your family to have a chance in the new and changing world. You favor the reindeer herding project because you think it would bring in more money and opportunities.

An area on the Yukon-Kuskokwim Delta

Question: **Should access to some wetland areas and harvest of geese prohibited in some areas?**

Role 1. You are opposed to any limits or restriction because you and everyone else need to harvest geese and use the wetlands . This is an important part of your culture and provides an important source of food that you don't think could be replaced.

Role 2. While out hunting, you have noticed that there are not as many geese as in past years. You think there should be some limitations on goose harvest and access to their nesting areas, at least for awhile.

Role 3. You love to hear the geese return in the spring. You understand that hunting is an important part of the culture of the people who live here, but worry that if no young are produced, soon no geese will be available for you to watch or for others to hunt.

Role 4. You live in California and hunt brant in the fall. You are concerned about harvest on the nesting grounds and think the birds should be left alone to produce as many birds as possible for everyone to harvest in the fall.

Role 5. You are a land use planner for the regional Native corporation. You are trying to plan for economic development that will benefit your shareholders. You oppose access restrictions that limit options for mining or oil and gas development on corporate lands.

Izembek Lagoon

Question: **Should offshore oil development be allowed in an area north of the lagoon, which is part of a National Wildlife Refuge?**

Role 1. You are responsible for maintaining the habitat and populations of wildlife in this area and know that an oil spill could be disastrous for the many birds that stop to feed here on migration and for the many birds that winter here.

Role 2. You are an avid waterfowl hunter and go out to Izembek to hunt every year. You are very concerned that an oil spill could harm the geese or the eelgrass at Izembek. You are a stockholder in the company that is seeking the permit for offshore development.

Role 3. You represent the company that wants to develop the offshore oil resources. You do not want to see any wildlife harmed by an oil spill either, but you think that your company's safety record and equipment for dealing with any oil spill are adequate.

Role 4. You think that enough wildlife habitat is protected already by federal refuges and parks. Everyone should get on with development now. You think we can't afford not to develop any potential oil field.

Role 5. You would like to see all oil development in Alaska stopped because you think it is just attracting more people to Alaska and ruining what all of us here have. You think that when there are more people, there is less for everyone.

Washington Coast

Question: **The Chamber of Commerce has proposed building a shipping port in the large bay near your town in order to accomodate the growing shipping industry in your town. Should the port be built?**

Role 1. You are the town mayor. Building the port facility will create 1500 construction related jobs, and will help revive the local economy of the town. If you can get the port approved, you think your next election will be assured.

Role 2. You are the president of a local nature club. Your members are opposed to the port development because you feel it will harm the beauty of the environment and the ducks, geese, and shorebirds that need the natural wetlands that now surround the bay.

Role 3. You are a small boat owner. You are opposed to the port development because you feel the big ships will crowd out the small boats and you won't be able to enjoy sailing anymore.

Role 4. You are an out of work construction worker. Your government benefits have almost run out and you aren't sure where you'll get the money you need to buy food for your 5 children. You think that construction of the port will provide a job for you and others.

Role 5. You are concerned about wildlife that use the bay, but from what you've seen the birds are only in the bay for a few weeks in the spring and fall, so you think that the bay can't be that important for them. Your brother is out of work and needs a job.

Oregon Coast

Question: **Should the wetlands surrounding a large saltwater bay near your town be filled in to provide more land for homes and businesses?**

Role 1. You are a wealthy real estate developer who is interested in building condominiums in the area once the wetland is filled. As far as you can see the land is a worthless swamp anyway. If it were filled in it could be worth millions of dollars.

Role 2. You are a birdwatcher. You have seen more and more wetlands in the area filled in over the past several years, and this is just about the only one left. If it is filled in, most birds will have to move elsewhere. You think the area should be made into a wildlife sanctuary.

Role 3. You rent an apartment in the town because you can't find any land to build a house on. You would really like to have a waterfront house so you could look out over the water.

Role 4. You are a member of the chamber of commerce. You'd like the town to expand and be able to attract more businesses. About the only remaining land that could be developed is the wetland area around the bay.

Role 5. You are an avid waterfowl hunter. You know that biologists think habitat loss is a probable factor causing declines of some goose populations. You want to be able to continue to hunt geese and realize that its up to you to protect their habitat in your town.

California Coast

Question: **Should a channel be dredged out of the lagoon to shorten the distance boats must travel to reach the open sea?**

Role 1. You are opposed to dredging the channel because it seems to you a waste of taxpayers money. There is already a channel that connects the lagoon and the open ocean and it only takes 20 minutes to use it even from the most distant part of the lagoon.

Role 2. You are a fisherman and would like to see the channel dredged because it would allow you to get out to sea faster when the weather was good and the season open. The fishing seasons for some fish are so short that every minute counts.

Role 3. You are a city planner and would like to see the dredging plan approved. In the long run you think it would mean more boats using the harbor and thus more revenue for the city.

Role 4. You would like to stop the dredging plan because it will ruin the saltmarsh habitat in the area. This will force a variety of wildlife that rely on the area to move elsewhere. You think the wildlife have more right to use the area than people do.

Role 5. You are the owner of a company that runs a dredge and would like to be able to bid on the dredging work once it has been approved. You expect that the contract will be for several hundred thousand dollars, and that would really help your business out.

A Bay in Mexico

Question: **Should some businessmen be allowed to build a recreational hotel and resort for American tourists near the shore of a rich coastal lagoon?**

Role 1. You are a very poor farmer. You do not really want to have American tourists around, but realize that your family could probably earn some much needed money by selling handmade items to the tourists or by working in the resort hotel.

Role 2. You are an avid waterfowl hunter. You would like to be able to travel to this lagoon and hunt waterfowl because the hunting seasons and bag limits in Mexico are more liberal than in your home state. Since the resort hotel would provide air charter access and comfortable accomodations, it would make a dream hunting trip possible.

Role 3. You are a biologist concerned about waterfowl populations that have recently declined. One factor that may be contributing to the declines is additional hunting pressure in Mexico where some species overwinter. You heard about the proposed resort and are very concerned that it would increase the number of hunters that would travel to Mexico, and thus increase the harvest of waterfowl in Mexico.

Role 4. You are a leader in your town and want to help the many poor people of your town. The builders of the proposed resort have told you that they will hire local people for many of the jobs created by the resort development. They have agreed to help establish better medical facilities and schools ifyou will support the resort.

Role 5. You are a wildlife photographer and like to get away from towns and people in order to study and observe animals. This rich lagoon in Mexico has become one of your favorite places to photograph various wildlife. In addition to being upset that more people will be attracted to this wild area, you are concerned that the disturbance caused by so many people will drive the wildlife out of the area.

THE CARIBOU POPULATION GAME

Objectives:

1. Students will practice math skills of addition, subtraction, and multiplication.

2. Students will understand that the size of wildlife populations change due to changes in the numbers of births and deaths.

3. Students will be able to identify the various factors that cause deaths in wildlife populations.

Materials:

The Caribou Population Game Board, Calving, Spring, Summer, Fall and Winter Cards, and Caribou Population Score Cards
(Photocopy score cards for each individual or team of students.) A pair of dice, pencils, calculators (optional).

Procedure:

1. Students can play this game in teams, or as individuals. Place the game board on a table with the Season Cards in the proper piles. Give each player, or team, a Caribou Population Scorecard and a player. All teams begin with a starting population of 10,000 animals. (Or specify some other number.) They should mark this number on their scorecard. The game begins in the spring, so all game markers should be placed on the Spring Square labeled Start.

2. The starting team picks up a Calving Card, reads it aloud, and works through the calculations to find out the number of calves produced by their population (calculate according to instructions on the card). Other players also make the calculations to prevent Team 1 from making any calculation errors. When all teams have approved the calculations, Team 1 records the number of calves produced.

3. Team 1 then throws the dice again, and moves again. Each time their marker lands on a square marked Seasonal Chance, they must draw a card from the appropriate pile (Spring, Summer, Fall, or Winter). They should read the card aloud to other team members. All students perform the calculations required by the card. The team whose play it is, reports the results of their calculations. If all players agree their calculations are correct, they record the number of animals that died in the appropriate column on their scorecard. They then toss the dice and move again.

4. When Team 1's marker has completed the circle and returned to Start, another team begins to toss the dice, move their marker and draw cards. After all teams have rounded the board, everyone calculates the change in their team's population size (Starting Population plus Number of Calves Produced, minus Total Number of Animals that Died, equals the New Population Size). The team with the largest remaining population wins. Or play additional rounds, remembering to calculate using the new population size each year. If several rounds are played, any team whose population did not show a continual decline wins—or the team with the highest average population size.

Advanced Version:

This version is somewhat more accurate, but is more complicated to play. The advanced version is played using the same board and cards, but attention must be paid to the kind of animals that die (adult bull or cow, immature, or calf). The advanced version scoreboard requires additional calculations as adult cow, adult bull, immature, and calf mortality are calculated separately. Also, the number of calves produced depends on the number of adult cows. Each year the number of adult cows equals the number of adult cows surviving the previous year plus the number of immature females that survived the previous year. The number of immatures will equal the number of calves that survived the previous year.

Possible evaluation:

Ask students to list the factors that affect the number of births (kind of wildlife, population size, habitat) and the factors that affect the number of deaths in a wildlife population (habitat, predation, parasites, diseases, accidents, weather, and human activities). Have them explain why wildlife populations change (due to differences in the number of births and deaths each year).

The Caribou Game

This game can be played as a class activity or at an activity station.

Directions:

Each player should begin with the same size starting population. All calculations are made as percentages, so you may set the number as 1,000, 10,000 or some other number.

1. Each player begins at *START* by moving to the calving grounds and drawing a *Calving Card*. They should then calculate the number of calves born by following the instructions on this card. (Note to Teachers: these calculations are designed to account for the fact that only a certain proportion of the population are adult females, and only a certain proportion of these produce a calf.) The number of calves produced should be recorded on the player's scorecard.
2. The player then tosses the pair of dice and moves the indicated number of squares into the *Spring Season*. Each square with a design background is a *Seasonal Chance Square*. When a player's marker lands on a *Seasonal Chance Square*, they should note which cause of death the square represents (compare the design to the key on the Game Board.) The percent of animals killed by this factor will be doubled (multiplied by 2). The player then draws a *Seasonal Chance Card* for the appropriate season *(Spring, Summer, Fall, or Winter)* and records the percent of calves, and percent of adults killed by each factor. Be sure to double the percent(s) killed by the factor indicated by the Seasonal Chance Square.
3. The player should then toss the dice again and move again. If the player lands on another Seasonal Chance Square in the <u>same season</u>, they must double the percent killed by the new factor indicated, unless the factor indicated is the same as on the previous toss. If that is the case, the player can toss the dice again. When the player reaches a Change of Season square, they must stop, and calculate the number of animals that survived the previous season (See Calculation Instructions below). recoT This number should be recorded in the appropriate line and column, <u>and on the line for next season's</u> *Number of Surviving Adults (or calves).*
4. The game can continue with this player completing a full year of play (as described in The Caribou Game activity) or players can alternate turns. Players can check each other's work, (also as described in The Caribou Game activity) or turn in their scorecards for later checking by the teacher. When all players have completed the year, everyone should calculate their *New Population Size.*

Note: The Scorecard can be used for 3 years of play, but beyond this players will need additional cards. You may have players graph the changes in their population size, if the game is played for 2 or more "years".

Calculation Instructions

1. Add the percentages killed by all causes, within a season, together to get *Total Percent Killed.*
2. [Calculate: *Number of Adults (or calves) Killed = (Number of Adults (or calves) * Total Percent Killed) ÷ 100*]
   Record this number on the scorecard.
3. Calculate the *Number of Surviving Adults (or calves) =*
   [*(Number of Adults (or calves)) -- (Number of Adults (or calves) Killed*]
4. Calculate: *Total Number of Adults (or calves) Killed*
   = Sum of the Numbers Killed in Each Season
   and *New Population Size = [Total Number of Adults (year beginning) + Total Number of Calves Produced] -- [Total Number of Adults Killed + Total Number of Calves Killed].* 2

CALVING CARD 1

Calculate the number of calves produced as the Number of Adults times 0.50 (to obtain number of breeding females), then this number times 0.80 to obtain number of calves born. (If this is the second year or later, be sure to use the new population size before calculating.)

CALVING CARD 2

Calculate the number of calves produced as the Number of Adults times 0.60 (to obtain number of breeding females), then this number times 0.85 to obtain number of calves born. (If this is the second year or later, be sure to use the new population size before calculating.)

CALVING CARD 3

Calculate the number of calves produced as the Number of Adults times 0.65 (to obtain number of breeding females), then this number times 0.90 to obtain number of calves born. (If this is the second year or later, be sure to use the new population size before calculating.)

CALVING CARD 4

Calculate the number of calves produced as the Number of Adults times 0.45 (to obtain number of breeding females), then this number times 0.75 to obtain number of calves born. (If this is the second year or later, be sure to use the new population size before calculating.)

CALVING CARD 5

Calculate the number of calves produced as the Number of Adults times 0.65 (to obtain number of breeding females), then this number times 0.85 to obtain number of calves born. (If this is the second year or later, be sure to use the new population size before calculating.)

CALVING CARD 6

Calculate the number of calves produced as the Number of Adults times 0.50 (to obtain number of breeding females), then this number times 0.65 to obtain number of calves born. (If this is the second year or later, be sure to use the new population size before calculating.)

CALVING CARD 7

Calculate the number of calves produced as the Number of Adults times 0.55 (to obtain number of breeding females), then this number times 0.75 to obtain number of calves born. (If this is the second year or later, be sure to use the new population size before calculating.)

CALVING CARD 8

Calculate the number of calves produced as the Number of Adults times 0.45 (to obtain number of breeding females), then this number times 0.90 to obtain number of calves born. (If this is the second year or later, be sure to use the new population size before calculating.)

Spring Chance Card 1

Weather--A mild spring, most caribou find adequate food. 1% of adults die when trapped by an ice jam during a river crossing.
Predation--Predator populations are fairly low, but 5% of calves are killed by wolves, brown bears and other predators.
Diseases and Parasites--2% of the calves born die as a result of disease.
Accidents--A lightening bolt hits part of the herd, 1% of the calves and 0.5% of the adults were killed.
Human Activities--Human activities did not affect the herd this spring.

Spring Chance Card 2

Weather--Several wet, cold days during the calving period. 5% of the calves die.
Predation--Predator populations are low, but 6% of calves and 0.5% of adults are killed by wolves, brown bears and other predators.
Diseases and Parasites--0.5% of the calves born die as a result of disease.
Accidents--0.5% of the calves are born a little early and drown while trying to migrate with the herd across a river.
Human Activities--Human activities did not affect the herd this spring.

Spring Chance Card 3

Weather--A spell of severe cold and snow causes 7% of calves to die, and 1% of adults.
Predation--8% of calves and 1% of adult cows are killed by wolves, brown bears and other predators.
Diseases and Parasites--An outbreak of disease weakens some cows, 0.9% are die or are killed by predators as a result.
Accidents--0.5% of adults become injured and die.
Human Activities--Many airplane, and helicopter over flights. Few deaths are clearly attributed to this disturbance, but 0.5% of adults are found dead.

Spring Chance Card 4

Weather--Heavy rains and breakup swell rivers, 3% of adults drown.
Predation--12% of calves, 2% of adults are killed by wolves, brown bears and other predators.
Diseases and Parasites--0.05% of adults and 1.5% of calves weakened by parasites and ultimately die.
Accidents--0.05% of adults killed by accidents including broken legs.
Human Activities--1% of adults killed when the herd crossed a highway.

Spring Chance Card 5

Weather--A short spell of bad weather, 3% of calves die and 0.5% of adults.
Predation--10% of calves and 1% of adults are killed by wolves, brown bears and other predators.
Diseases and Parasites--1% of the calves born die as a result of disease.
Accidents--No accidental deaths occurred.
Human Activities--Human activities did not affect the herd this spring.

Spring Chance Card 6

Weather--The spring is unusually cold and breakup occurs late. 11% of calves die and 2% of adults.
Predation--Predator populations are fairly low, but 7% of calves are killed by wolves, brown bears and other predators.
Diseases and Parasites--1% of the calves born die as a result of disease.
Accidents--0.2% of animals die due to various accidents.
Human Activities--One calf is killed accidentally when researchers attempt to radiotag it.

Spring Chance Card 7

Weather--A mild spring, only 2% of calves and 0.5% of adult deaths can be attributed to weather.
Predation--Predator populations are high, 13% of calves are killed by wolves, brown bears and other predators.
Diseases and Parasites--1% of the calves born and 0.2% of adults die as a result of disease.
Accidents--No known accidents occur.
Human Activities--Development in a calving area forces the herd to calve elsewhere; 3% calves and 1% adults die due to varied causes at the less preferred site.

Spring Chance Card 8

Weather--Harsh weather all spring makes calves more susceptible to diseases and predators--7% are killed due to weather.
Predation--12% of calves are killed by wolves, brown bears and other predators.
Diseases and Parasites--1.6% of the calves born and 0.1% of adults die as a result of disease.
Accidents--1.3% of calves and 0.7% of adults die due to accidents.
Human Activities--1% of adults are killed by illegal hunters.

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Summer Chance Card 1

Weather--Summer weather is hot so insect populations are high; 1% of calves and 0.5% of adults die of exhaustion.
Predation--Predator populations are fairly low, but 4% of calves are killed by wolves, brown bears and other predators.
Diseases and Parasites--2% of the calves and 1% of adults die as a result of disease.
Accidents--No deaths due to accidents.
Human Activities--0.5% of the adults become entangled in wire that was left on the ground by people. These animals starve to death.

Summer Chance Card 2

Weather--No deaths can be attributed to weather this summer.
Predation--11% of calves and 1% of adults are killed by wolves, brown bears and other predators.
Diseases and Parasites--0.5% of the calves and adults are weakened and die as a result of parasitic infestations.
Accidents--1% of the calves are injured and die directly or are later killed by predators.
Human Activities--The herd is spooked several times by people photographing them from the air. 2% die as a result of injuries or are weakened by stress and later killed by predation or disease.

Summer Chance Card 3

Weather--An unusually cold summer, but only 0.3% of calves and 0.1% of adults die as a result.
Predation--8% of calves and 0.5% of adults are killed by wolves, brown bears and other predators.
Diseases and Parasites--1% of the calves and adults are weakened and die as a result of parasitic infestations.
Accidents--2% of the calves and 1% of adults are injured and die directly or are later killed by predators.
Human Activities--3% of adults are legally harvested. Another 2% are illegally taken.

Summer Chance Card 4

Weather--No animals die as a result of weather.
Predation--3% of calves and 0.5% of adults are killed by wolves, brown bears and other predators.
Diseases and Parasites--2% of the calves and adults are weakened and die as a result of parasitic infestations.
Accidents--0.8% of the calves and 0.5% of adults are injured and die directly or are later killed by predators.
Human Activities--5% of the adults are harvested.

Summer Chance Card 5

Weather--A freak storm during the peak of mosquito season kills 3% of adults and 5% of calves that became marooned on an offshore island.
Predation--7% of calves and 1% of adults are killed by wolves, brown bears and other predators.
Diseases and Parasites--0.5% of the calves and adults are weakened and die as a result of disease.
Accidents--2% of the calves and adults become injured and die directly or are later killed by predators.
Human Activities--Human activities did not cause any deaths.

Summer Chance Card 6

Weather--No deaths can be attributed to weather this summer.
Predation--5% of calves and 0.5% of adults are killed by wolves, brown bears and other predators.
Diseases and Parasites--0.5% of the calves and adults are weakened and die as a result of parasitic infestations.
Accidents--0.8% of the calves and 0.6% of adults are injured and die directly or are later killed by predators.
Human Activities--6% of the adults are harvested by people.

Summer Chance Card 7

Weather--Heavy rains cause mudslides that make travel difficult. 3% of calves and 1% of adults die of causes related to this.
Predation--12% of calves and 3% of adults are killed by wolves, brown bears and other predators.
Diseases and Parasites--1% of the calves and adults are weakened and die as a result of parasitic infestations.
Accidents--A landslide caused by the heavy rains kills 1.2% of the herd.
Human Activities--6% of adults are killed by humans--legal and illegal harvest combined.

Summer Chance Card 8

Weather--0.5% of calves die and 0.2% of adults die as a result of poor weather.
Predation--9% of calves and 3% of adults are killed by wolves, brown bears and other predators.
Diseases and Parasites--No adults are killed by diseases or parasites. 0.7% of calves die due to weakening by disease.
Accidents--0.6% of the calves and 0.3% of adults are injured and die directly or are later killed by predators.
Human Activities--1% of adults are hit by cars or trucks while trying to cross a highway.

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Fall Chance Card 1

Weather--Early snowstorms force caribou to move southward earlier in the year--2% of calves are unable to keep up and die.
Predation--3% of calves and 0.5% of adults are killed by wolves, brown bears and other predators.
Diseases and Parasites--0.2% of the calves and adults are weakened and die as a result of parasitic infestations.
Accidents--0.5% of adults are killed as a result of injuries they got during the rut.
Human Activities--2% of the adults are harvested.

Fall Chance Card 2

Weather--Fall weather is mild, no animals die as a result of weather.
Predation--1% of calves and no adults are killed by wolves, brown bears and other predators.
Diseases and Parasites--No animals die as a result of diseases or parasites.
Accidents--1.0% of adults are killed as a result of injuries they got during the rut.
Human Activities--5% of the adults are killed by people.

Fall Chance Card 3

Weather--Heavy snow in one area makes food hard to find, 1% of adults and 2% of calves die of starvation.
Predation--2% of calves and 0.5% of adult are killed by wolves, brown bears and other predators.
Diseases and Parasites--1% of the calves and adults are weakened and die as result of parasitic infestations.
Accidents--1.5% of adults die as a result of injuries they got during the rut.
Human Activities--7% of the adults are harvested.

Fall Chance Card 4
Weather--A mild fall, only 1% of calves die during the migration.
Predation--2% of calves and 1% of adults are killed by wolves, brown bears, and other predators.
Diseases and Parasites--Only 0.5% of calves or adults die due to diseases or parasites.
Accidents--3% of adults and 5% of calves drown while trying to swim across a swollen river.
Human Activities--Development of an area once used by caribou forces them to travel an extra 150 miles across rugged terrain, 0.5% of the calves die.

Fall Chance Card 5
Weather--No deaths are attributable to weather.
Predation--3% of calves and 1% of adults are killed by wolves and other predators.
Diseases and Parasites--0.7% of adults and 1.2% of calves succumb to the effects of parasites and diseases.
Accidents--0.6% of adults break their legs or pull a muscle and and are later killed by predators.
Human Activities--A new disease introduced to the caribou from domestic livestock causes 10% of the adults and 13% of calves to die.

Fall Chance Card 6

Weather--Poor weather causes 0.5% of calves and 0.1% of adults to die.
Predation--1.5% of calves and 0.5% of adults are killed by predators.
Diseases and Parasites--1% of calves and adults are killed by diseases or parasites.
Accidents--0.7% of calves die as a result of injuries they got during migration movements and the rut.
Human Activities--6% of the adults are harvested.

Fall Chance Card 7

Weather--Heavy rains swell rivers and a few animals die on each crossing. In total, 1.5% of adults and 2.5% of calves drown.
Predation--Predator populations are low, only 1% of calves and no adult deaths are attributable to predation.
Diseases and Parasites--No deaths are attributable to diseases or parasites.
Accidents--1.0% of the adults die of unknown causes.
Human Activities--2% of the herd is harvested.

Fall Chance Card 8

Weather--No deaths are attributable to weather.
Predation--4% of calves and 1.5% of adults are killed by wolves, brown bears, and other predators.
Diseases and Parasites--0.9% of calves and 0.4% of adults die due to diseases or parasites.
Accidents--0.7% of calves, and 1% of adults die due to injuries.
Human Activities--2% of adults and 1% of calves are killed when the herd crosses a major highway.

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Winter Chance Card 1

Weather--Early and heavy snowfall makes food difficult to find, and hampers escape from predators. 6% of adults and 7% of calves die of starvation or predation.
Predation--3% of adults and 2% of calves are killed by predators.
Diseases and Parasites--The combined effects of cold, food shortage, and parasites causes 3% of the adults to die.
Accidents--An avalanche kills 0.5% of the adults.
Human Activities--2% of adults are killed by a train while using an area transected by a railway.

Winter Chance Card 2

Weather--Light snowfall and a mild winter allow most animals to survive. Only 1% of calves and adults die.
Predation--1% of adults and 3% of calves are killed by predators.
Diseases and Parasites--The combined effects of cold, food shortage, and parasites causes 1.2% of the adults to die.
Accidents--No animals are killed by accidents.
Human Activities--4% of adults are illegally harvested.

Winter Chance Card 3

Weather--Deep snow makes food difficult to find, and hampers escape from predators. 5% of adults and 3% of calves die of starvation or predation.
Predation--5% of adults and 8% of calves are killed by predators.
Diseases and Parasites--The combined effects of cold, food shortage, and parasites causes 1.7% of the adults to die.
Accidents--0.5% of adults and calves die as a result of various accidents.
Human Activities--9% of adults are harvested illegally. 3% are legally harvested.

Winter Chance Card 4

Weather--Moderate snowfall and cold weather causes some deaths; 4% of adults and 6% of calves die.
Predation--2% of adults and 3% of calves die.
Diseases and Parasites--The combined effects of cold, food shortage, and parasites causes 1% of the adults to die.
Accidents--No animals die as a result of accidents.
Human Activities--1% of adults are killed when migrating across a highway.

Winter Chance Card 5

Weather--Light snowfall and mild weather allows most caribou to survive winter. 2.5% of adults and 2% of calves die.
Predation-- Predators are abundant and deep snow makes it easy for them to kill caribou; 3.5% of adults and 4.7% of calves die.
Diseases and Parasites--The combined effects of cold, food shortage, and parasites causes 1.9% of the adults to die.
Accidents--No animals are killed due to accidents.
Human Activities--2.3% of the adults and calves are killed by a military test bomb.

Winter Chance Card 6

Weather--The numbers killed by winter weather is within the normal range--2% of adults and 3% of calves starve.
Predation--3.5% of adults and 4% of calves are killed by predators.
Diseases and Parasites--The combined effects of cold, food shortage, and parasites causes 0.7% of the adults to die.
Accidents--A strong earthquake causes landslides and avalanches, 0.6% of the adults and calves are killed.
Human Activities--1% of adults are killed by legal hunters, 2% are illegally killed.

Winter Chance Card 7

Weather--Early and heavy snowfall makes food difficult to find, and hampers escape from predators. 5% of adults and 6% of calves die of starvation or predation.
Predation--2% of adults and 2.5% of calves are killed by predators.
Diseases and Parasites--The combined effects of cold, food shortage, and parasites causes 1.3% of the adults to die.
Accidents--0.5% of adults die due to unknown causes.
Human Activities--2% of adults are legally harvested.

Winter Chance Card 8

Weather--A mild winter, only 1% of adults and calves die of starvation or other effects of weather.
Predation--2.7% of adults and 3.3% of calves are killed by predators.
Diseases and Parasites--The combined effects of cold, food shortage, and parasites causes 2% of the adults to die.
Accidents--0.5% of adults and 0.5% of calves die as a result of injuries.
Human Activities--Illegal harrassment of the herd causes 0.5% of the adults and 0.7% of the calves to die of exhaustion and starvation.

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THE
CARIBOU
GAME SCORECARD

	YEAR 1				YEAR 1				YEAR 1			
	SPRING	SUMMER	FALL	WINTER	SPRING	SUMMER	FALL	WINTER	SPRING	SUMMER	FALL	WINTER
BEGINNING POPULATION												
SURVIVING POPULATION												
PERCENT OF ADULTS KILLED BY												
____ WEATHER												
____ PREDATORS												
____ DIS. & PAR.												
____ ACCIDENTS												
____ HUMAN ACT.												
TOTAL PERCENT ADULTS DYING												
NUMBER OF ADULTS DYING												
NUMBER OF ADULTS SURVIVING												
NUMBER OF CALVES BORN												
PERCENT OF CALVES KILLED BY												
____ WEATHER												
____ PREDATORS												
____ DIS.& PAR.												
____ ACCIDENTS												
____ HUMAN ACT.												
TOTAL PERCENT DYING												
NUMBER OF CALVES DYING												
NUMBER OF CALVES SURVIVING												
YEAR END POPULATION												